Fracture Mechanism of Non-straight Fissure in Brittle Material

Guowei Ma

Hebei University of Technology; UWA, guowei.ma@uwa.edu.au

Extensive research has been conducted to investigate straight fissure failure characteristics of brittle materials, whereas still much is to be explicated for the crack initiation and coalescence with non-straight fissures. In this study, 3D-printed photosensitive resin samples with an S-shaped fissure subject to uniaxial tension are physically tested, theoretically derived, and numerically simulated. In particular, the influence of effective curvature of the fissure on the cracking evolution is investigated. From the current study, a single pattern of coalescence is observed to be formed through exclusively tensile cracks, while two cracking categories of S-shaped fissures are identified as tip cracking and non-tip cracking based on the crack initiation position. The fissure effective curvature has considerable influence on the failure pattern of the specimens. When the effective curvature is A/c=0.5, cracks tends to appear around the tips of the fissure. When the effective curvature is large, e.g., A/c=1, 1.5, 2, 2.5, 3, the damage initiates around the non-tips (inflection points) of the fissure. The S-shaped fissure can be treated as a kinked crack in view of its geometric pattern. The main fissure dominates cracking development to render non-tip cracking. On the other hand, the influence of fissure bifurcation can be ignored. The simulated results agree well with the experimental results. The findings from current study should be helpful in in rationalizing the stability and safety measures for underground engineering projects with non-straight fissures.